Organizational Efficiency in the Implementation of 4.0 Technologies in Logistics Operators in the Colombian Caribbean Region

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Abstract. Logistics operators in Colombian Caribbean region structure their activities based on the grouping of processes linked to intralogistics activities. Consequently, this project aims to demonstrate that the improvement in the organizational efficiency index of these organizations should be developed through the implementation of 4.0 technologies, using the strengths provided by the implementation of simulation concepts in decision-making tool for intralogistics activities in logistics operators on Colombian Caribbean region. For fulfillment of the objectives, literary research framed in three categories: intralogistics, technology 4.0 and business efficiency, and instruments to assess the efficiency indexes obtained with the application of the technologies 4.0 in the parent company object of study, to evaluate the supply chain based on intralogistics activities 4.0, using as method the research line of operations management as for the analysis of the thematic axis the supply chains based on intralogistics operations. To this end, a series of logical steps are established, starting from the perception and direct treatment to establish the elements involved in the measurement of efficiency in organizations based on decision-making according to the scenarios that allow determining the impact of technologies 4.0 and ending with evaluations of the same based on the theoretical average index, of the challenges and perspectives that the dynamics of the international system and especially the agreements of the international free trade treaties that the neo-grenadine nation has approved and materialized in the last decade to make its economy more fruitful and fundamentally to the organizations of its different regions.

Keywords: Intralogistics · Technologies 4.0 · Business efficiency

1 Introduction

Since the beginning of history, the human species has had to use its ingenuity to supply its basic needs, among the most important of which is food. To do so, they supplied

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this need with what was closest to the environment where they settled because at that time they did not yet have the knowledge of storage, distribution and transportation as methods of solution for their basic needs, the transport of provisions or goods was reduced to the amount that an individual or persons could mobilize and, consequently, the deposit of perishable provisions was only within reach for a short period, which forced citizens to settle near the sources of supply to take advantage of the goods and food that the environment could provide or that nature granted.

Even in the 21st century, in many parts of the planet, the consumption and production of goods at present only within specific geographical locations. Even today, there are worrying patterns in developing countries such as Asia, Latin America, Africa, and Australia, in which a group of its inhabitants lives reduced and autonomous spaces villages, where the consumer goods needed by the population are developed or managed in the vicinity of the settlements. By the above, it is evident that the logistical procedures are vital for the periodic activities of the individual or of a community in general, thus it follows that today's organizations explore multiple options in the field of management and administration of the supply chain of a set of diverse factors, rules and laws, from the most conservative dimensions of marketing, manufacturing, accounting, procurement and transportation, to the branches of applied mathematics, knowledge of organizational context and economic management, to respond to the demands of consumers on a global scale, following contemporary paradigms.

For this reason, the logistics work carried out within the communities has high relevance for the economic and social strengthening, especially of logistics operators and their supply chain. In some cases in the Caribbean region of Colombia, especially in the Atlantic, the subject of this study, the organization responsible for the permanent management of the various economic movements and industrialization, generating sources of employment and well-being for the residents, guaranteeing access to the items and accessories required to meet your expectations, with the influx of the Magdalena River as a primary factor, the needs described above are evident. Thus, the definition of the supply chainis as: "The supply chain, or simply supply chain, is a chain of suppliers, factories, warehouses, distribution centers, and retailers through which inputs are procured and transformed into products for delivery to the end customer" [1]. Intralogistics procedures of logistics operators represent almost thirty percent of the logistics costs of organizations in Colombia, which, according to the National Planning Department of Colombia, are equivalent to about fifteen percent of an organization's sales [2]. In the case of Colombia, there is no interference in the logistics sector, especially intralogistics, and these discrete steps in the organization are of great organizational importance and increase the cost of all products in the domestic market [3]. Following Crespo [4] "The costs derived from the logistics process, depending on the levels of the country, are at several percentage points of difference for the nations of America and Europe. For example, when compared to the United States, this represents 8.7% of the sales achieved, while in Europe it increases to 11.9% and in Latin America the estimate is around 14.7%".

Within the components, costs in Intralogistics are a predominant factor in the economies of all countries worldwide. For Colombia, we do not have data on how much this value represents for the whole logistics distribution and supply chain, but for

Brazil, for example, it represents an average of twenty-eight percent of the costs, that is, an important part of the value of an article to the final buyer, is concentrated in the processes derived between the creation of the final product and the final delivery to the client [5]. Consequently, to find instruments that tend to improve decision making that influence the indicators and, in turn, the factors that make up the organizational efficiency index in logistics operators, the aim is to find solutions to the challenge of inserting 4.0 technologies in intralogistics tasks, to achieve the purpose and respond to the problems of the organizations under study.

1.1 Requirements of Logistics Operators in the Colombian Caribbean Region

Under the problem statement, the purpose of this research focuses on: Improving the organizational efficiency index through the implementation of 4.0 technologies using simulation as a tool for decision making in intralogistics processes in the Colombian Caribbean region. The relationship items of the present research are aimed at establishing the following specific paragraphs:

i) As a logistic operator in the Atlántico suite, carry out diagnostics of logistic and technical processes.
ii) Create simulation scenarios that facilitate the decision-making process for the implementation of technology in the internal operations of logistics operators in the Colombian Caribbean Atlantic.
iii) A statistical demonstration of the relevance of the research interests of this project as a reference in the implementation of technology in logistics processes.
iv) To evaluate the impact on the performance index of the organization of the internal processes of the logistics operators within the department of Atlántico through the investigated scenarios.

The current study is based on the consideration that the scenario assessment will provide greater certainty in decision-making regarding the application of technologies 4.0 in an overall context of comparing needs of the organization and will serve as an opening to a general development approach, the implementation, and evaluation of other areas of the industry in their intralogistics procedures. Organizational efficiency indices can be measured in those factors that influence decision-making, through the application of simulation in the intralogistics tasks or activities of logistics operators in the Colombian Caribbean region. The panorama of expansion of the logistic sector generates to us the requirement to incorporate new technologies, to understand and respond to the challenges of achieving sustainability in the market through the application of indices of continuous improvement in organizational efficiency, including the dynamics of the strategy and international standardization, as a fundamental aspect describing intelligent decision-making [6].

1.2 The Supply Chain in the Logistics Sector

Different authors establish the beginning of the study of logistics to military development Philippe-Pierre [7], Jordi [8], Roux [9], Ballou [10], Carranza [11]. This is primarily

because the concept of logistics took its contemporary definition with the first theoretical evidence on military logistics at the end of World War I and achieved its greatest boom with the definition of logistics operation from a more complex and planned view of the time of the invasion of Europe in the development of World War II [10]. Accordingly, the relationship of logistic processes with military activities has been known since the beginning of the term logistics; during the end of the 4th century, treaties are evidenced by logistics in this military development. The agreements are justified by the logistics in this military advance. However, history shows other important non-military examples in the application of logistical skills such as the architecture of the pyramids in Egypt [12], who demystify their unique origin in the military branch and teach logistics as a discipline that took its first steps alongside the beginning of humanity and its social development [13].

Also, in the area of business, the description of the concept was established in 1844 by the French engineer Jules Dupuit who incorporated the notion of exchanging (Trade-off) a price for others and the selection among the different types of transport according to cost criteria [10]. The first writings that refer to logistics are evidenced in the year 1961 [14]. They capture the benefits of the planned logistics administration. Likewise, Drucker [15], highlighted the definition of logistics as one of the most important and last frontiers that enable real indicators of business efficiency and detailed it as "the dark continent of the economy" [12]. All these events gave rise to a growth in interest and development of the concept of logistics within the academic and business community. As a result, in 1962 the first association of logistics professionals, teachers, and managers was to promote education in this discipline and that there would be a reciprocity of ideas. The National Council of Physical Distribution Management (NCPDM), founded in 1963, officially defined logistics as "A set of activities that are responsible for the efficient movement of finished products from the end of the production line to the consumer and that, in some cases, includes the movement of raw materials from the source to the line" [16].

1.3 The Imperative Need to Improve Corporate Performance Indicators

The organizations that are organizing given the coming decade of the 21st century, are characterized by being companies that seek to achieve and demonstrate a better practice in their operations, mitigating the negative impact generated today by the lack of control of intralogistics activities within the supply chain and the absorption of the environment of technologies 4.0. The supply chain encompasses all aspects of business, people, the company, technology, and physical infrastructure that allows the innovation of inputs towards transformation into goods and services through management in different processes until deriving in the final product of value for a potential customer or consumer. He notes that this is a very functional vision, both internal and external to the company, which does not develop relationships of integration and synchronization, is perceived as an inventory of the elements of a system called the supply chain.

The comprehensive study on collaboration within the supply chain focuses on the development of various planning procedures and delimits multiple analyses in the information. Increasing the range of management schemes on different hierarchical levels, decision-making and empirical environments allow solutions to problems arising from

intralogistics activities. The organizations that work in the Colombian Caribbean region, suffer these inconveniences in their intralogistics operations, Primarily logistics operators that show a considerable impact on their organizational efficiency index that in turn impacts on their productivity and competitiveness compared to different locations in the country and Latin America; the Colombian government under the leadership of President Iván Duque has framed the National Development Plan 2018–2022 called: "The Future Belongs to Everyone" and the strategic planning work of the Atlantic department of Governor Elsa Noguera: "Atlantic is the town", where it is added to the district strategic plans of the mayors of the cities of the department, include of primary relevance and rigorous compliance for the issue of logistics issues and their aspects as a fundamental aspect in the of productivity and competitiveness of the region and its companies.

Publications made worldwide, according to Botthof [19], establish that the costs of the logistic activities in the nations of Latin America and the Caribbean would contemplate a range between 50% and 80% more supported regarding the countries that are members of the Organization for Economic Cooperation and Development (OECD). Essentially in Colombia, due to the deviation of responsibility in the solution of the problems about road infrastructure, it admits the presence of a less efficient transport environment, poor quality in the management of the port environment through the appropriate use of capacity, and the minimum adaptation of other internal transport models, such as rail (used only for coal transport) or river transport, which also affects logistics operators. In this way, the BDI [20], argues that the logistics operators sector has a great opportunity for small and medium-sized enterprises, considering that logistics administration is part of the organization's most strategic activities, where the flow of costs that are formed is 19% of the Gross Domestic Product (GDP) in the countries of Latin America, evidenced especially by the complexity of customs processes among other elements. The inclusion of Information and Communication Technologies (ICT) in the area of Logistics in Colombia, remains in debt to increase the use of these technological advances, and specially to ensure that implementation determines a high impact of efficiency and effectiveness levels on logistics activities. Table 1 shows the demonstrated level of current inclusion of technologies in the logistics area and, specifically, their applicability in the logistics operators of the Colombian Caribbean region.

Information in the table above shows, using percentages, the degree of usability of technologies in intralogistics activities in the organizations above Colombian Caribbean region in accordance with the dynamics of the logistic field to total standards; the optimal level should be around 80% adaptability; however, we note that none of the technologies studied has reached international standards. For the foregoing, that the organizations in Colombia advance in modernization on the provision of logistics services, properly in the intralogistics activities of the sector, where relevant aspects are found such as infrastructure, performance indicators, management practices, and the increasing use of information systems to achieve organizational efficiency indices under the international standard.

Table 1. Applicable and applied technologies in Atlantic department logistics operators

ICTs in logistics operators	Available	Not Available
Optimization, planning and control of transport	57%	43%
Distribution Center Management (WMS)	28%	72%
Distribution Management System (DMS)	28%	72%
Business Transaction Management/Orders	28%	72%
Integrated WMS TMS	15%	85%
Demand management and planning software	24%	76%
ERP Interfaces	33%	67%
Fleet Management Software	45%	55%
Barcode system	24%	76%
Radiofrequency System	15%	85%
System for Invoicing/Auditor's	49%	51%
Real-time tracking and tracing system	73%	27%
Internet access for the client	63%	37%
Electronic Data Interchange System (EDI)	24%	76%
Picking Optimization System	15%	85%

2 Methodology

This research is framed in Operations Management in reference analysis of the thematic structure on the supply chain, about the intralogistics operations of logistics operators in the daily dynamics of the department of Atlántico in the Colombian Caribbean region. Through observation as a direct analysis activity evidence actions that impact decision-making in 4.0 technology implementation scenarios. Considering the above premise, a three-phase investigation is established:

i) Starts with a full analysis of the current situation in the studied companies taking as a reference the analysis of vertical and horizontal integration systems in the framework of technology 4.0. Makes it possible to establish the current reality of the logistics operators in terms of the aspects under study in terms of their efficiency indexes.
ii) Then with the use of computational software and the application of Statistics, the possible scenarios for the analysis of the factors that will evaluate the impact of the parameters of the organizational efficiency index as the object of study of this research are specified.

iii) The results and evaluations according to the scenarios are quantitatively established according to the impact generated by implementing 4.0 technologies in the intralogistics processes on the improvement in organizational efficiency, using the procedure defined by Perez [23], which highlights three considerations in the characterization process: vertical and horizontal integration and, lastly, the use of technologies 4.0, as described in Table 2.

Table 2. Mapping the organizational structure

Consideration	Description
Vertical integration	It is based on the socio-technical system and the value creation modules
Horizontal integration	It is based on operations management requirements
Technologies 4.0	It contains the tools studied in the literature analysis
Scenario 1	Presents the current status of the organization under study
Scenario 2	Introduces organization with layout improvements
Scenario 3	Shows the implementation of technologies 4.0
Statistical field	Contains the tools for the analysis of the solution of the problem posed

The structure expressed in Table 2 is constituted as the starting point to know the current situation that the organization has in the study, i.e., evidence of the mechanisms and unfinished activities, loss events, and critical items of the operation, thus, the structured form of the instruments developed and applied in this research to analyses the current situation of logistics operators in the Colombian Caribbean region regarding the applicability of technologies 4.0; from the study of the aspects of vertical and horizontal integration, the creation of the three scenarios of analysis in the employability of the factors that determine the indicators of organizational efficiency, necessary steps for the solution of the problem studied.

This adaptation, developed by Perez [23] and Orozco [28], must be carried out strategically so that it responds satisfactorily to the requirements involved in intralogistics activities in the function of organizational efficiency. Taking into account the presented above, we can observe in Fig. 1 the results of the application of the tool of vertical and horizontal integration in the framework of applicability technologies 4.0 in the organization object of the present investigation, the parent company object of this research, which shows a ratio of vertical integration defined in 65%, delimited by the internal perception in the inclusion of 4.0 technologies and 64% of internal adaptation.

Figure 1 shows not only the diagnostic outcome of the integration and absorption of 4.0 technologies in the study organization but also details the individual characteristics of the organization and how they are adapting the inclusion of technologies, in the case of horizontal validation, it is evident that there is an opportunity gap for the adoption of emerging technologies, for such a case, it is shown that the external perception is around 59% of adaptability and the internal vision is 53%; on the other hand, the vertical validation shows us a different scenario of greater adaptation towards technological

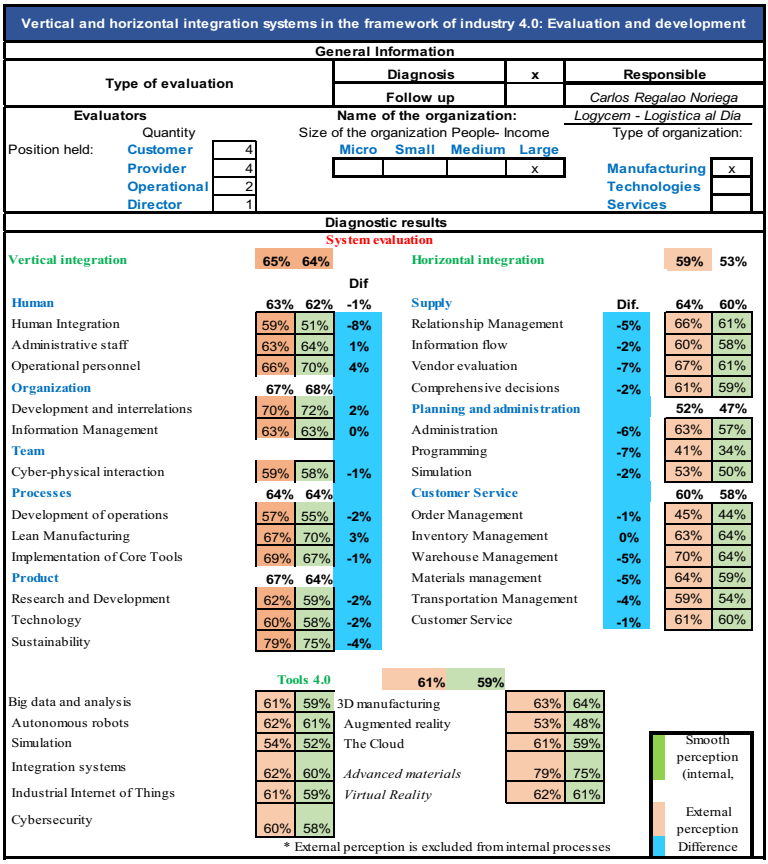

Fig. 1. Results of the application of the vertical and horizontal integration tool in the framework of applicability technologies 4.0

inclusion since it exceeds 60%, which leads to having a very good level of adaptation with favorable opportunities for improvement.

2.1 Scenario Analysis and Statistical Approximation

There are various ways to analyze the possible decisions that will lead us to a prosperous future, to put ourselves before the problems that can arise in an organization, and to identify aspects of continuous improvement, is what companies are looking for today; the above defines what this study puts into practice based on its methodological objective that consists in analyzing three scenarios through the applicability of the simulation as a means of analysis to define the impact generate the inclusion or absorption of technologies 4.0 organizations in the Colombian Caribbean region, specifically in logistics operators, to validate the increase or improvement of the organizational efficiency index, thus evidencing proposals in the implementation and analysis of solutions options to the problems of this research, shown in Fig. 2.

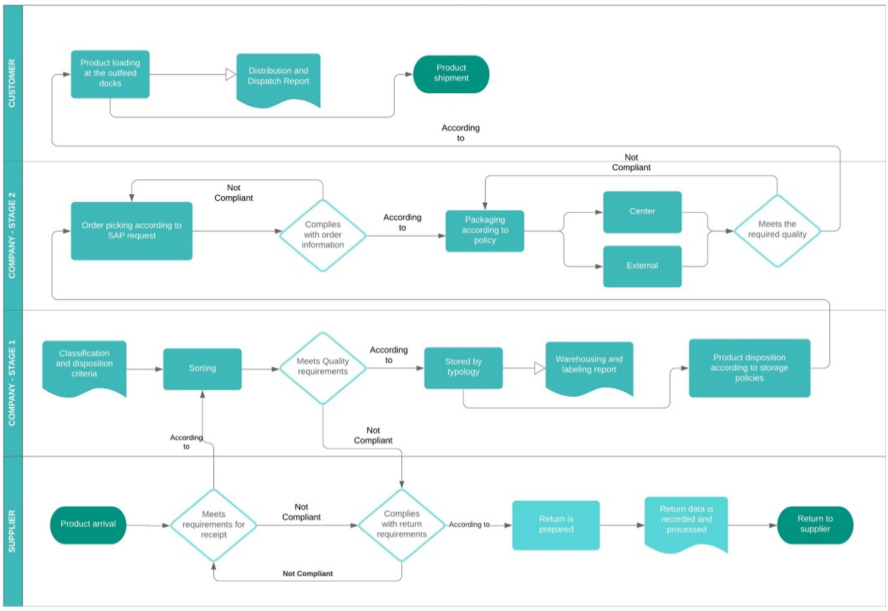

Fig. 2. Flowchart of the current process in the logistic operator

The main characteristic of intralogistics activity is the environment of storage, loading and unloading of raw materials as finished products or in transit depending on the nature and operation of the logistics operator. The above is specified in Fig. 2, where the operation of the warehouse to the other areas is evidenced, as well as the distribution process, loading, and unloading where the flow of products is centered, materials and skilled labor toward picking activities primarily, just as it is evident that the data generated is collected throughout the process, but there is no particular function for them other than to archive or save them.

Figure 3 shows the characteristics of the logistics operator with the operation factors framed in a different layout methodology, where it allows improving aspects of product reception and storage capacity, however, it does not allow giving an adequate solution to the finished product storage processes, since it maintains the results of the variables of the current scenario of the organization and the improvements in the loading and unloading process are not significant, impacting very little or nothing in the organizational efficiency index as shown in the analysis Table 4.

Figure 4 describes the functioning of the intralogistics processes of the logistics operator involving technology 4.0, in which substantial changes in the processes are evident. It details the results obtained by the logistics operator when applying this type of technology, the results according to the factors studied, and the gradual increase in organizational efficiency indicators, establishing the scenario as the ideal one for providing solutions to the problems of the logistics operators studied in this research project, represented in the analysis Table 3.

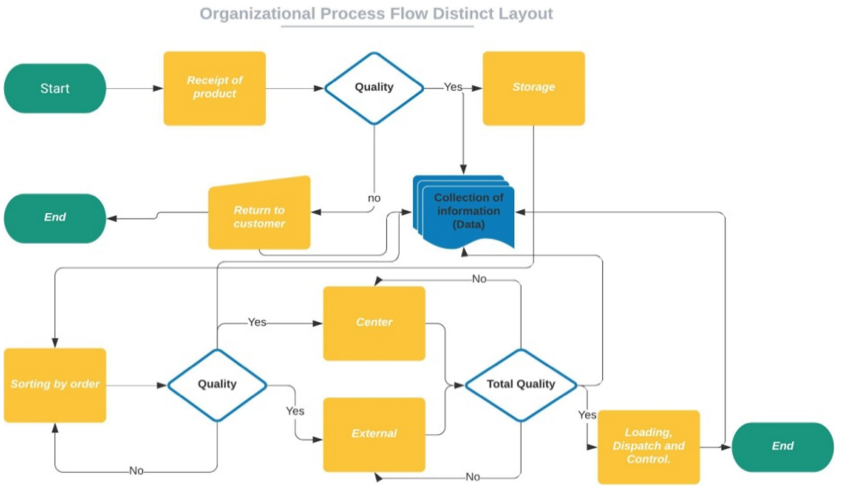

Fig. 3. Diagram of the intralogistics process within the organization's supply chain with a different layout

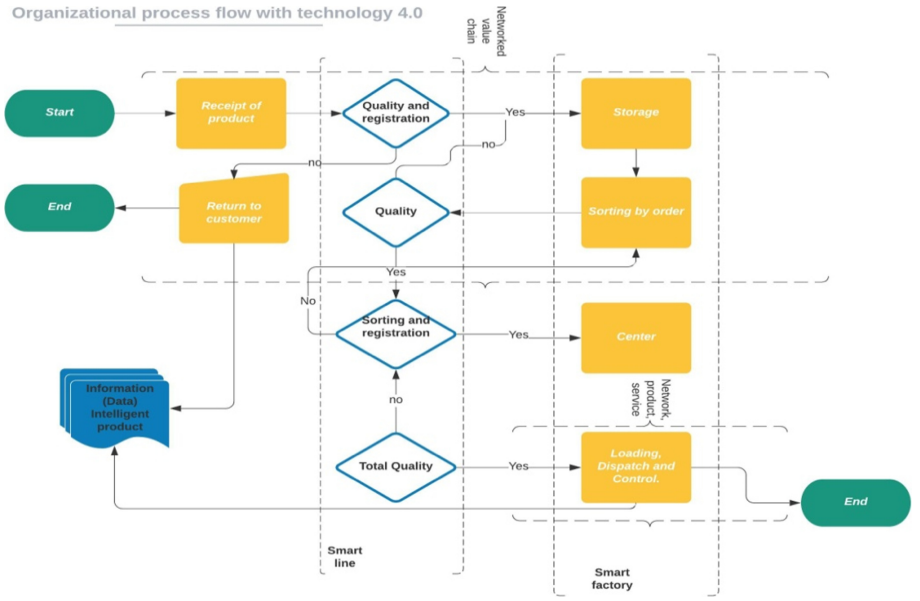

Fig. 4. Diagram of the intralogistic process within the organization's supply chain with 4.0 technology

Table 3. Optimization characteristics in the study setting

	Warehouse	Distribution center
Principal function	Storage management and inventory layout	Flow management products
"Cost Driver" principal	Space and facilities	Transport, Hand working
Order cycle	Months, weeks	Days, hours
Activities of value-added	Punctual, in rotation Cyclical	They are an intrinsic part of process
Expeditions	On customer demand and Vendors	According to orders
Rotation of inventory	3, 6, 9, 12 - days	12, 24, 48, 96, 120 - days

Table 3 above are data obtained from the current scenario of the organization under study, where it is evident the application of concepts in the areas of process optimization, reengineering and distribution of plants for the full identification of the problem posed and the solution to it. As Jung puts it [24], "the new world scenario of globalization has made organizations transform, adapt and play new roles". In this way, international organizations and governments identified control strategies to mitigate the negative impact that can be generated in the process such as a new millennium project, created to discuss and evaluate the future challenges that humanity may have with 4.0 technologies [25].

3 Analysis of the Results Achieved and Statistical Evidence

The results of the instrument used are presented, and based on them, the solutions are presented according to the simulation model optimization used in each scenario the representation of the operations or activity of the logistics operators of the Colombian Caribbean region that are the object of this research study. The form of usability for the achievement of the results analyzed in this section is directed to the methodology exposed in the previous section, under the application of the proportional fixation criterion. However, the maintenance of statistical assumptions in the calculations is vital for the effectiveness of the inferences of this study. In the first subsection, a general description is presented on how the logistic operator selected for the present study has been found ahead of the component evaluated in the research. Next, it is established how are the relationships between the factors of the recommended scenarios and ends with impact analysis associated them, it is necessary to point out and identify the inferences derived from the data collected through an instrument with coherence, cohesion, reliability, and validity, which are indispensable elements in research activities:

i) The Instrument: For this work, a reliable instrument is used to identify the organizational characteristics based on the horizontal and vertical analysis in the adaptation of 4.0 technologies, which allows defining the current situation of the organization and the future scenarios of analysis based on the information collected, which

seeks to verify the absorption capacity of new technologies through the measurement quadrants, as well as the promotion and use of technology, giving present research project the base tool for the delimitation of the study factors of the model to be used. Determining the degree to which an instrument provides consistent and systematic data [26]. For the above, Cronbach's alpha is used to measure interior uniformity, to locate the results between the items based on the variances and correlations, for which the following formula should be applied:

$$\propto = \left[\frac{k}{k-1}\right]\left[1 - \sum_{i=1}^{k} \frac{S_i^2}{S_t^2}\right]$$

Where: k is the number of reagents
$i = 1$: defines the index to which an initial value called the lower limit is assigned, in this case 1.
$S_i^2 =$ is the variance of each item.
$S_t^2 =$ is the variance of the instrument.
Reliability checks are carried out through the provision of measurement data instruments, prove their effectiveness in the field of logistics operators. For the purpose, the population to be studied is evaluated according to the characteristics of the logistics operators of the Colombian Caribbean region above 44 participants based on a critical analysis from the organization that is the subject of this study was selected to be a reference as a matrix in the adoption of the main characteristics in terms of adaptability to other organizations in the same environment. In the development analysis with the formula previously described, obtaining as a result $\alpha = 0.98$; affirming that its structure, based on the reliability criterion, is evaluated as excellent.

ii) Scenarios: They are defined as the development of the events that can occur or dissipate depending on the applicability of the simulation via optimization. For the present study, three scenarios are presented for the respective analysis and correlation with the feasibility of immersion of technologies 4.0 in the intralogistics activities of the logistics operator studied. For each scenario, the application of the factors that determine the evaluation of the organizational efficiency indexes is evidenced, developing the studied problem in each of the facets of the context with its distinctive results evidenced in Table 4, in which three aspects of mutual interest and determined in the analysis of the results of the vertical and horizontal integration systems are observed [23]:

- Supplier analysis: strengths, mutually beneficial relationships, communication, and integration between the organization under study and the organizations that supply the necessary inputs for the operation are evidenced.
- Organizational analysis: It establishes aspects inherent to the intralogistics activity within the organization and its improvement evaluations, with which it synthesizes the object of study of the research.
- Customer analysis: Observes the dependent and independent variables on which the requirements towards the product are based, according to the expectations

and needs of the customer; in this aspect the organizational efficiency indicator is established.

From the above, the Flexsim software as a working tool of the present research project allows to visualize the three study scenarios with the characteristics previously defined and allows to establish the conditions of decision making that impact on the improvement of organizational efficiency.

iii) Evaluation Method: The results obtained from the scenarios using the simulation model via optimization according to the tests of approval, integrity, and reliability of the simulation allow us to obtain the data evidenced in Table 4, which shows a comparison between the factors according to the indicators that interact for this study and how they fluctuate according to the scenario used, with the above it is established that the incorporation of 4.0 technologies is the necessary option to solve the problem posed and the objective of this research.
The table above shows the results obtained by simulating the scenarios established and parameterized in the statistical assumptions by the results of the previous analysis, which translates into obtaining information for decision making and the assumption as the solution to improve organizational efficiency, the objective of this study, focused on the adoption of 4.0 technology for the antiphlogistic processes of the logistics operators of the Colombian Caribbean region.

iv) Analysis of the research: It presents the analysis of the results obtained with the company object of study of the research about the diagnosis made, the analysis of the scenarios using the simulation model via optimization and the suggestions for the applicability of 4.0 technologies, to achieve higher levels of organizational efficiency. From the above, we can determine that the factors defined by the application of the instruments are directly related to the organizational efficiency index and taking into account the results detailed in Table 4 in the 4.0 technology scenario in relation to the scenarios of the current situation and different layout, it is determined that it is imperative to invest in the application of 4.0 technologies, which will allow the logistics operator under study to obtain a gradual and consistent improvement in its organizational efficiency. In addition, the following are established as analysis factors: Information Management and Business Model, Being the latter the one that is more favored of the use of the technologies 4.0 in the intralogistics activities of the logistic operators for the Colombian Caribbean region, which supposes an increase of the quality of the infrastructures until 90.45%. Likewise, it shows the level found in terms of implementation of technologies and the opportunities for new adaptations for them.

Similarly, Fig. 5 determines the application and result of the instrument that measures the capacity of the inclusion of 4.0 technologies in the company under study. Cronbach's Alpha coefficient is the most widely used indicator of the reliability of psychometric scales in the social sciences, which gives us a measure of the internal consistency of the reagents that make up a scale. If this measure is high, we assume that we have evidence of the homogeneity of the scale, i.e. that the items are "pointing" in the same direction, which is evidenced by the application of this measure to the results in Fig. 6. That is, we assume that our scale is Tau equivalent or essentially Tau equivalent. In conclusion,

Table 4. Table of analysis of the projected scenarios

Factors	Indicators	Scenarios		
		Current	Different distribution or layout	Technology 4.0
Information management	Volume of purchases	32.12%	30.59%	34.55%
	Inventory time	28.56%	36.45%	50.61%
Strategic planning	Perfect delivery received	36.54%	30.29%	44.37%
	Inventory time	28.78%	50.18%	58.85%
	Types of transport	22.54%	82.62%	59.93%
	Punctuality of the offices	30.23%	42.51%	73.17%
Subcontracting	Perfect delivery received	8.71%	14.63%	44.77%
Business model	Certificate of suppliers	54.38%	74.48%	84.49%
Logistic barriers	Quality of infrastructure	64.81%	80.07%	90.45%
Cost	Order quality	70.23%	58.15%	68.38%
	Perfect delivery received	36.19%	30.74%	44.02%
	Inventory time	28.70%	36.52%	38.27%
Risk	Volume of purchases	22.76%	38.38%	28.68%
	Efficiency in the offices customs officers	82.94%	86.17%	84.48%
Distribution strategy	Types of transport	8.67%	6.05%	11.33%
	Punctuality of the offices	40.42%	30.72%	44.57%

about the results, the instruments present a reliable and trustworthy data, which allows to characterize and observe the need that the logistic operator has as shown in Fig. 7 for the primordial factor that influences the cost variable, which is the angular point of the measurement of the organizational efficiency; therefore it is necessary that the company under study passes from quadrant 2 to 3 as shown in Fig. 5 for to the adaptation of the technologies of the industry 4.0, and consequently give solution to the problem studied in the present project.

Figure 5 shows the result of the application of the instrument of vertical and horizontal integration in the framework of industry 4.0; which is described as the diagnostic result of

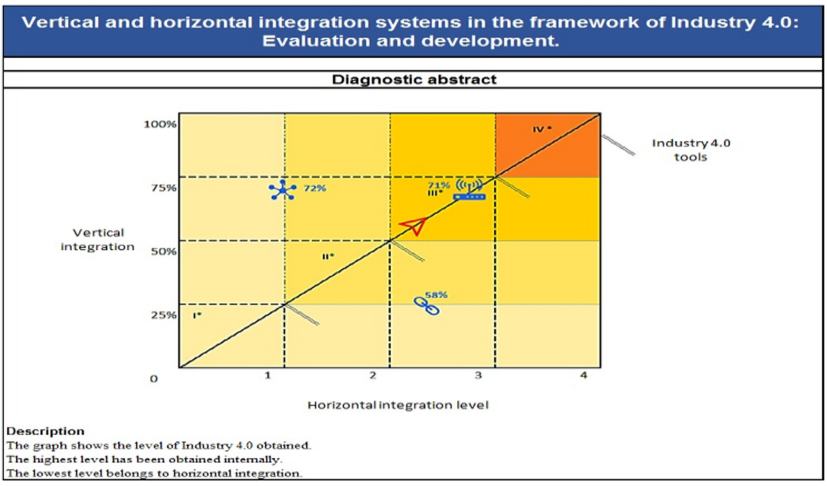

Fig. 5. Level of technology implemented in the organization

the organization under study, showing the reality of the environment studied, the ability to adopt new technologies and the level of absorption it has for it. The organization under study according to the results is in a very good quadrant of opportunity established between 71% to 75% of absorption which allows a good margin of improvement to continue growing in the adaptability of emerging technologies in terms of continuous improvement of its processes and indicators.

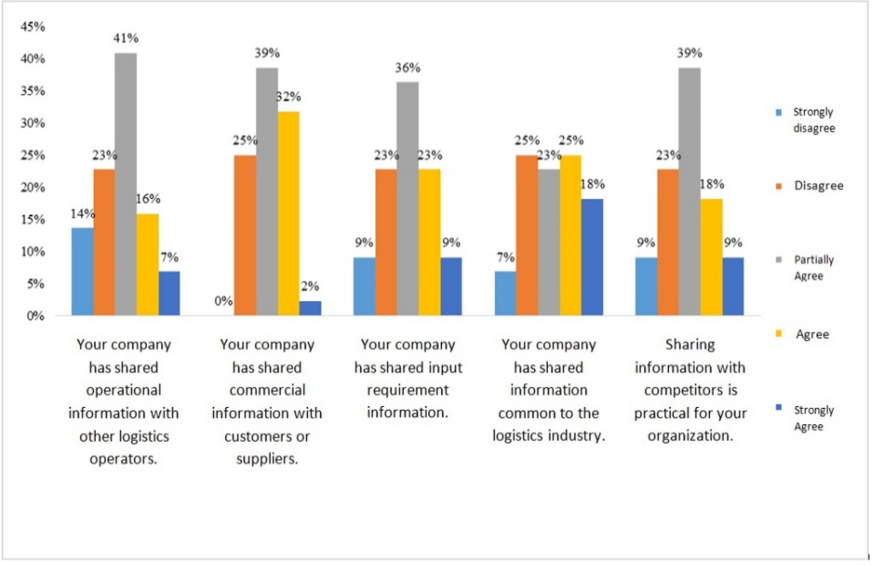

Fig. 6. Information management as a major factor in improving organizational efficiency

Figure 6 shows the results of the predominant factor in this study, Information Management, the result of the internal load generator instrument; with which it was obtained as a result for this factor for logistics operators under the indicators of purchase volume and inventory time, it was estimated that 41% disagreed. Thirty-nine percent strongly agreed with this strategy. Next, we examined whether the company shares operational and/or commercial information with its customers or suppliers, such as safety information, driver databases, delivery schedules, rates, etc., and found that 32% of the companies disagreed with sharing information, while 25% agreed with this option for their processes. To manage group purchases, it is established that 25% of the company partially agree to share information to manage group purchases, followed by 25% who agree and do so, together with 26% who disagree to use this method in their information and purchasing processes.

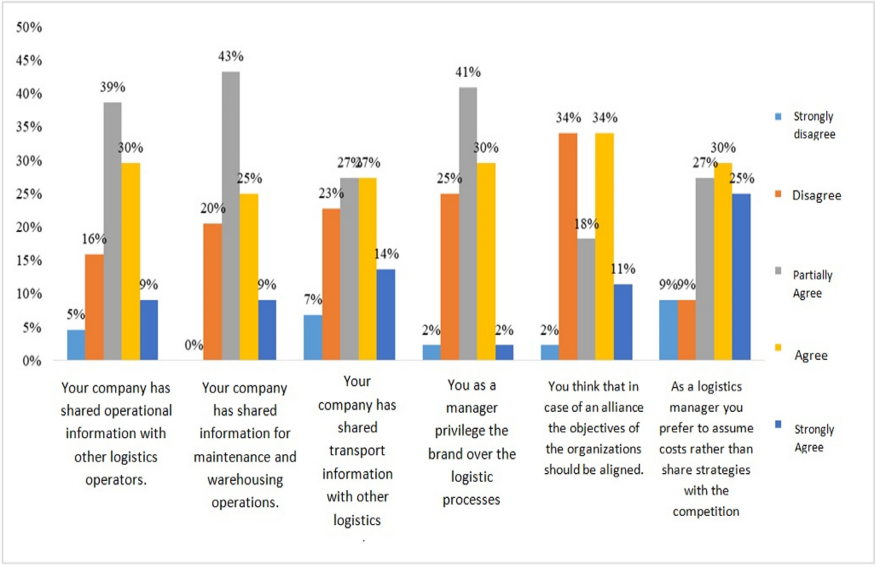

Fig. 7. Business model as a major factor in improving organizational efficiency

Figure 7 shows the results of the second predominant factor in the organization under study, the Business Model, which has a very dynamic system in the way it operationalizes its processes in terms of supply chain collaboration, in the search for increased organizational efficiency. In which it is observed that 39% of the company under study emphasizes to be partially in agreement in sharing resources, followed by 30% in agreement. We went on to examine whether the company has shared facilities for cross docking operations or for vehicle maintenance with other logistics operators, where 43% of the company highlighted that they partially agree and have done so, followed by 25% who confirmed that they agree with the strategy. The study continues to determine the participation in joint ventures by examining if the company has participated in joint ventures of transportation operations with other logistics operators, where it is obtained that 27%

of the company highlights to agree and have implemented it and 27% of the studied population indicates to be partially in agreement with the participation. The next question is whether the logistics manager gives priority to brand recall over the costs derived from not sharing some cargo operations with competitors. In this topic, the analysis is synthesized in privileging their brand over the costs derived, through the instrument it is determined that 45% of the companies consider to be partially in agreement, while 30% agree with the privilege of their brand. The analysis ends by asking whether the company thinks that in the case of a possible collaborative alliance, the business model of its company is incompatible with that of its competitors. It can be seen that 34% of the company agrees and has done so, followed by 34% who disagree.

4 Conclusions and Discussions of Information Analysis

The present study is framed in a quantitative research, under an epistemologically positivist approach, with which it is developed in the analysis of real facts evidenced by practice, identifying the main factors through the indicators that are used in the construction of scenarios on the application of simulation via optimization for the adoption of technologies 4.0 in the intralogistic activities towards the improvement of the efficiency indices of the logistic operators of the Colombian Caribbean region. The results obtained in this study validate trends correlated with information management factors and the business model as the central axis of the scenarios studied. The results achieved are defined as a far-reaching contribution to decision-making within the organizations of the Caribbean region concerning to logistics operators, likewise, the aim is to contribute to the state of knowledge through the influence exerted by the authors or theoreticians studied and evidenced in this research, who with their work allowed to give an orientation due to the analysis of information.

For the present study, a substantial improvement was obtained in the factors related to the organizational efficiency index, described in Table 4, where we can evidence a major increase between 4% and 11% per item studied. The operationalization of the factors, determine a series of aspects that allow evidencing the need to improve all the stages of the intralogistics process, in general terms the organization and its studied sector must identify that allow them to improve their decision making that influence the organizational efficiency. By the application of Industry 4.0 technologies in intralogistics processes in general terms: special attention should be paid to the variables of strategic planning and subcontracting, as these are the ones that gradually impact intralogistics costs.

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